PROTOTYPE OIL SHALE LEASING PROGRAM

UTAH TRACT U-a
PRELIMINARY DEVELOPMENT PLAN

Submitted by

PHILLIPS PETROLEUM COMPANY
and
SUN OIL COMPANY (DELAWARE)

PROTOTYPE OIL SHALE LEASING PROGRAM

UTAH TRACT U-a

PRELIMINARY DEVELOPMENT PLAN

Submitted by

PHILLIPS PETROLEUM COMPANY

and

SUN OIL COMPANY (DELAWARE)

TO THE
STATE DIRECTOR
UTAH STATE OFFICE
BUREAU OF LAND MANAGEMENT
FEDERAL BUILDING
125 SOUTH STATE
SALT LAKE CITY, UTAH 84138

March, 1974

PROTOTYPE OIL SHALE LEASING PROGRAM

UTAH TRACT U-a

PRELIMINARY DEVELOPMENT PLAN

TABLE OF CONTENTS

TABLE OF CONTENTS (continued)

SECTION 1

SECTION 2

SECTION 3

SECTION 4

1.0 INTRODUCTION

This Preliminary Development Plan is submitted by Sun Oil Company (Delaware) and Phillips Petroleum Company, lessee of Utah Tract U-a, in accordance with instructions published by the Department of Interior in the Federal Register Vol. 38 No. 230, November 30, 1973. Lessee (U-a) understands that this plan is required for the lessor's guidance in establishing initial supervision of activity on Tract U-a. The plan is submitted with the understanding that it is neither binding on Lessee (U-a) or the Lessor and, of itself, does not authorize any action by Lessee (U-a). This plan should be viewed as a preliminary plan subject to modification as additional information is developed.

In keeping with the objectives of the Oil Shale Prototype Leasing Program and the country's need for additional energy sources, Sun and Phillips believe the development of oil shale resources is a necessary part of our nation's drive toward becoming domestically self sufficient.

However, before large scale production can commence, many factors involving technical, environmental and financial considerations, siting locations for plants and waste disposal, as well as equipment design and delivery must be resolved. Two stages of development are now envisioned in order to bring the tract into commercial production.

The objectives of the initial period of activity on Tract U-a will be: (1) to confirm the environmental, technical, and economic feasibility of the overall development scheme; (2) to prepare the detailed development plan required by Section 10(a) of the Lease; (3) obtain early approval of the detailed development plan, and (4) to initiate those activities necessary for commencement of detailed development promptly after such plan is approved.

During the Initial Stage we will acquire and develop enough information to prepare a Detailed Development Plan and to begin the engineering design of the commercial production facilities. A concerted effort will be aimed at developing the technology required to meet our goals.

During this initial stage studies will be performed for general evaluations of the total tract resources, the optimum mining method, disposal of overburden and spent shale, evaluation of off-site locations as plant sites and disposal areas, and access and utility corridors and methods of retorting and refining. The information gained in the initial stage will provide an engineering, economic, and environmental framework for the second or commercial production stage. Expenditures on operations for development of the Leased Deposits could commence during the initial stage provided early approval of the detailed development plan is obtained.

The second stage would complete the two major tasks of 1) commercial plant construction and 2) development of an underground mine. These activities would begin when technology was developed and all siting problems were resolved.

Sun and Phillips intend to develop Tract U-a at a pace and in a manner compatible with the spirit and requirements of the Prototype Oil Shale Leasing Program. The time table for lease development depends on 1) development of an efficient commercial retort module, 2) design of an integrated shale oil complex that meets environmental requirements, and 3) early approval of a detailed development plan. Sun and Phillips will work toward early initial production with expectations of reaching design capacity of about 50,000 barrels per day within eight years.

Section 2 of the attached plan describes the commercial development concept for Utah Tract U-a.

Section 3 is concerned with the oil shale lease environmental stipulations and outlines a preliminary plan for attaining the criteria established for environmental monitoring and protection.

An Appendix contains the various charts, maps, and diagrams that are referred to in the plan.

SECTION 4

SECTION 3

SECTION 2

2.0 COMMERCIAL DEVELOPMENT CONCEPT

2.1 Oil Shale Mining Concept

An underground mine of the room-and-pillar type will be utilized to develop oil shale activities on Tract U-a. We believe that underground room-and-pillar mining represents the only demonstrated technology currently available for Tract U-a oil shale development. We believe that underground mining represents the quickest and most reliable approach to developing Utah's oil shale reserves. This approach offers the advantage of early development by conventional mining, yet does not preclude the eventual utilization of the mine for advanced recovery techniques.

The following discussion is based on an initial conceptual mining scheme. Although realistically based on current technology it represents only one approach. Variations in many aspects will probably result following the exploratory drilling program and detailed mine engineering studies. Modifications to the mining plan could include variations in

- Type of Entry: vertical vs incline
- Location of Entry: on-tract vs off-tract
- Room Design: square pillars, rib pillars, etc.
- Ore Transport Method: conveyors, trucks, or rail
- Crushing Scheme: portable vs stationary crushers
- Method of Advance: single face vs heading and bench.

2.1.1 Summary of Mine Plan

This conceptual plan assumes entry to the Mahogany bed via an inclined shaft from the south bank of the White River, with the plant located on the north side of the river. Mining was assumed to be on a checkerboard room and pillar pattern, with drilling by full-face jumbo. Broken ore will be loaded into rear-dump trucks by front-end loaders. Trucks will deliver to trains in the main haulageways for haulage to a primary crusher located near the foot of the shaft. Crushed ore will be hauled on conveyors via the incline and surface to the plant.

Spent shale from the retorts could be deposited on-tract or off-tract or possibly to mined-out areas underground by means of conveyors, abandoned ventilation shafts, and stowers. The alternative selected will depend on economic factors and available technology.

The mine on U-a will be designed to produce oil shale to support a processing plant of approximately 50,000 B/CD of refined shale oil. This requires the mining of about 25 million tons per year of oil shale yielding about 30 gal/ton of crude shale oil. Mining operations will be conducted approximately 350 days per year with 20 shifts per week scheduled.

2.1.2 Mine Development

Mine entry is assumed to be by an inclined shaft located in Section 15, T10S, R24E. Beginning at 4960 elevation, a shaft inclined at -13° could be sunk 2772 feet, terminating near the southeast corner of the section at the base of the Mahogany bed. An inclined shaft was preferred to vertical because of more efficient hoisting of ore and to permit large mobile equipment to be driven directly into the mine without the dismantling and reassembly required with a vertical shaft.

The inclined shaft, 50 feet wide by 25 feet high, would contain a double roadway with concrete floor, ventilation pipe, airline, water line, electric lines, telephone, pump line, walkway, and a railway.

While driving the entry, the excavated rock would be spread between the portal and river to form a level mine yard on which surface facilities would be erected. These would consist of a 100 x 300-foot changehouse/office, parking area, tramway hoist, electric substation, storage for fuel and other supplies.

Following completion of the entry, the main haulage drift (60' wide x 40' high) would be driven to the north boundary of the tract; excavations would be made for shops, warehouse, electric substation, pump and sump, office, fuel storage, and crusher; the conveyor incline would be completed to the base of the crushed ore pocket; and the ventilation shaft for the shop area would be bored from surface. Conveyors would be installed to the surface in the inclines and cross country to the coarse ore pile at the plantsite.

During the next year, the shop equipment and crusher would be installed. Mobile equipment ordered earlier would now be on hand to permit resumption of the main haulage drift, crosscuts and panel drifts. For this conceptual plan these openings were located on a square pattern as shown on Figure 1, to form mining panels 1450' x 1450'.

Before regular mining or stoping could begin, a second entry would be required and a vertical shaft for this purpose has been located on the main haulageway about 1-1/4 miles south of the shop area. This bored shaft would be equipped with automatic elevator, ladders, and telephone line.

Upon completion of the vertical shafts, development of stoping panels could begin, gradually increasing the number of working places as crews gained proficiency and equipment became available.

2.1.3 Stoping

Each mine panel would be encompassed by a rib pillar to protect the haulageways on each side, with entries cut near each corner for passage of equipment. For this conceptual plan a checkerboard pillar pattern has been assumed, with pillars and rooms of equal width, probably 50 to 60 feet. About 60-70 percent of each panel is excavated, 30-40 percent remaining as pillars.

Drilling of room faces is with a two-drill mobile jumbo which will have a self-contained air compressor. Drill holes will be loaded with ammonium nitrate-fuel oil (ANFO) prills placed pneumatically by powdermen working from an ANFO loader platform. Prills will be supplied by a mixer truck. This explosive mixture will be detonated at the end of shifts, using primers and electric blasting caps. Drill holes along walls will be more closely spaced, lightly charged, and blasted in proper sequence for pre-splitting in order to reduce damage to pillars. The floor and roof are presumed to be smooth parting planes.

Broken ore will be excavated by large rubber-tired front-end loaders into trucks driven directly to the muck piles through previously excavated rooms.

Loaded 75-ton rear dump trucks will haul the rock to the main haulageways. Loads will be either dumped directly into hopper feeders for train loading or onto temporary stockpiles which can be loaded by front-end loaders when the train arrives. All mobile units will have radio communication to more efficiently coordinate movement.

Following removal of the broken rock, the walls will be scaled with a modified Gradall to remove all loose rock. Roof bolting and scaling will be accomplished with a Giraffe equipped for scaling and with twin roof bolt drills.

Each panel will be equipped with a large, bored ventilation shaft, ducting and auxiliary fans as required. An exhaust fan mounted at the surface will draw the ventilating air through the inclined shaft, through the working places and up the shaft.

Allowance has been made for road and general maintenance by providing rubber-tired dozers, graders, pickups, service trucks, water trucks, fuel trucks, mobile crane, small tools, road and ditch crew, track crew, and a general labor crew.

Most repair work will be accomplished in the underground shops which, in addition to regular shop tools, will have an overhead crane in the passageway between shops and stores which will extend out into the main haulageway.

2.1.4 Ore Transport

In the early years during production buildup, much of the broken ore would likely be hauled directly to the crusher pocket by truck. However, provision has been made for train haulage to obviate the need for a number of mobile crushers required for conveyor transport.

Moving cars will dump automatically into the crusher pocket. A gyratory crusher will reduce all rock to less than 12 inches. The broken rock will be supplied evenly to the main conveyor by an apron feeder for delivery to the plant site.

An oil shale stockpile will be maintained at the retort to provide an uninterrupted supply. From the storage pile, the oil shale will be conveyed to the secondary crushers and finally to the retort feed hoppers.

2.2 Retorting

The only practical means known for recovering oil from oil shale is retorting, which involves heating the oil shale to high temperatures to convert the solid organic material (kerogen) into oil and gas and then collecting the vapors in a separation system. While many different retorting systems have been researched and patented, no system of the size required exists in the world today.

Considering the lack of commercially proven retorting technology and the overall magnitude of the financial risk inherent to pioneering a commercial oil shale venture, it is imperative that a concerted and aggressive program of retort development and engineering analysis be undertaken.

Conceptually our preferred technology for retorting involves a combination of two retorts currently under development, the TOSCO II for fine shale retorting and the Paraho retort for coarse shale.

The TOSCO II retort utilizes circulating hot solids to retort approximately -1/2" shale. This retort has been demonstrated at 1000 TPD and is probably closest to commercialization. Fines (less than 1/4 to 1/2") produced in mining and during the primary and secondary crushing operations could be utilized in the TOSCO II retort.

The primary retort handling about 80-90 percent of the mine output would be a version of the Paraho kiln under development by Development Engineers Inc., at Anvil Points, Colorado. Sun and Phillips are participants in the funding of this program.

The retorting plant will consist of 6-8 Paraho retorts each with a diameter of 40-60 ft. We anticipate that these kilns might be direct fired with recycle gas produced by the retorting operation. The crushed and sized (-3", +1/4") shale will enter the top of the retort and gradually pass downward through the unit. The shale will be gradually heated to 900°F in order to drive off the kerogen in a vapor mist form. The overhead retort products will be completely contained and separated into gases, water, and raw shale oil product. Retorted shale leaves the bottom of the retort for disposal.

Raw shale oil is pipelined to the upgrading plant for further processing. The major portion of the light gaseous products will be compressed and piped to the refinery for fueling furnaces and process units. Some of the gas may be recycled for use in the retorting process. Retort water, containing soluble organic compounds, will be treated and reused or consumed in the wetting of retorted shale.

2.3 Upgrading

Crude shale oil from the retort is not a usable product in crude oil refineries. The crude shale oil has a high pour point, and high viscosity which need to be reduced for pipelining purposes. The crude shale oil also has nitrogen and sulfur compounds that must be removed. There are a number of processes commercially available to accomplish the steps outlined.

Products from the upgrading plant will include semi-refined shale oil, ammonia, coke, and sulfur. The engineering design of these facilities will depend upon the final choice of retort, availability of utilities, and environmental protection plans. The design of the upgrading plant as well as all other facilities will meet applicable environmental protection standards.

Description of Typical Upgrading Scheme

Raw shale oil will flow from the retort recovery system to the upgrading plant at about 52,000 B/D. The basic units in the refinery are a distillation column, hydrogenation units, hydrogen production facilities, coker, ammonia plant, and sulfur plant. A simplified process flow diagram is shown in Figure 2. Extensive hydrogenation facilities are required to catalytically hydrogenate the oil to remove nitrogen and sulfur compounds. The nitrogen compounds are converted by catalytic hydrogenation to ammonia; the sulfur compounds are converted to hydrogen sulfide. The two compounds are selectively stripped to separate the NH_3 and H_2S. The H_2S will be directed to a standard Claus sulfur plant for conversion of the H_2S to elemental sulfur. The tail gases from the sulfur plant will be subsequently treated to reduce SO_2 emissions to the lowest practical level. Engineering studies indicate that concentration of SO_2 from the tail gas treatment facility will meet applicable regulations. Normally, elemental sulfur produced from a Claus plant is of sufficient quality such that the sulfur should be a salable by-product of the plant. Additional market research will be required to determine market conditions in the plant's geographical area.

Similarly, ammonia will be produced as a by-product. A market for the material will be sought within the geographic area. A limited amount of ammonia might be used internally as a fertilizer as part of the revegetation/rehabilitation program.

The heavy oil bottoms from the shale oil atmospheric distillation column will be directed to a delayed coking facility to thermally crack this heavy oil fraction to a lighter material. This cracked material will

be recycled back to the distillation unit. A market will be sought for the coke by-product. Conversely, the fuel value of this coke may be utilized as a combustion fuel within the plant.

The fuel oil product from the plant will be stored in floating roof petroleum storage tanks. Storage capacity will depend upon the product transportation mode chosen to move the product to market. We believe that a pipeline offers the best approach and perhaps can be jointly developed with other shale oil producers.

2.4 Location of On-Tract and Off-Tract Facilities

Refer to Figure 3 for locations of alternative sites.

2.4.1 Mine Entries

As discussed in the section on mining, the merits of vertical shaft vs inclined shaft entry will be evaluated. In continuing the concept of inclined shaft entry, a location in Section 15 T10S, R24E would be suitable. This location fits the mine requirement of inclined shaft to provide access to the ore body, and is suitable to fit the retort and plant site requirements as discussed later in this section. This is only one concept of a mine location and is subject to refinement.

If the detailed engineering evaluation indicates that a vertical shaft mine entry is superior to the inclined shaft, an on-tract site will be feasible. A location approximately in the center of the tract in the Northern part of Section 28, T10S, R24E, along Southam Canyon would be suitable for a main vertical shaft entry to a room and pillar mine operation.

2.4.2 Process Plant

There are several items to consider in selecting a site for the retort and upgrading plant. A location off-tract eliminates the potential hazard of slight ground subsidence inherent in a site over a mined-out area. An area of approximately 140 acres for raw shale stockpile, retorts, and upgrading plant is needed. The topography of the area must be considered for cost of preparation, drainage, and access to R.O.W. corridor. Soil conditions must be analyzed for the proper loading under process vessels. Another important consideration is the air distribution pattern around the potential plant site. As discussed in the environmental baseline program section, plant location will depend upon finding an area that will minimize the effect from air currents, thermal conditions, and topography.

The location in Section 10, T10S, R24E, for the process plant fits the requirements noted above based upon our preliminary evaluation. This location is fairly level; close to a potential water supply source; offers access to a potential spent shale disposal area; and generally fits our stipulated requirements. Before the final decision is made however, extensive site evaluations and engineering studies must be completed, and offsite agreement arrangements must be made.

In choosing a plant site for Tract U-a,consideration will be given to potential sites that can be shared by both U-a and U-b. The two tracts can share common R.O.W. corridors, roads, power sources, pipelines, and perhaps all surface facilities including retorts, upgrading plant, and spent shale disposal areas. This would help minimize the environmental impact and the socioeconomic impact on nearby communities.

2.4.3 Spent Shale Disposal

In our preliminary development plan, spent shale disposal was studied considering several variables. These include:

Underground disposal

On-Tract Surface Disposal

Off-Tract Surface Disposal

TOSCO II Retorted Shale and

Paraho Retorted and Spent Shale.

The EIS discusses disposing of a majority of the spent shale underground in mined out panels (Vol. III, Section III). While this has not been done in oil shale mining to date, it is considered a possibility by some mining engineers. Research will have to be conducted as to the feasibility and safety of this concept. It is conceivable that 60 percent of the spent shale could be returned underground after the mine has operated for some time.

An on-tract area for spent shale is shown as Area III on the topo map in the appendix (Figure 3). This area appears suitable from our examination of topographic maps and aerial photographs. This area, in the central and western portion of Tract U-a, appears to offer a topographical situation where the drainage is toward the center along Southam Canyon. This would help the effort to contain surface water runoff. Any spent shale disposal on-tract will be dependent on underground mine design considerations.

Another area partly on Tract U-a is shown in Figure 3 as Area II in Section 34. This area, while appearing to be appropriate from the standpoint of containment, may not be large enough to utilize.

South of Tract U-a in Sections 3, 4, 9, and 10, T11S, R24E, is a large area (Area I) that meets the disposal requirements based upon

preliminary evaluation. Suitable arrangements with off-tract landowners must be made in order to consider these areas for spent shale disposal.

North of Tract U-a and the White River are several potential spent shale disposal areas designated as Area IV and V. These areas are attractive in that the drainage is away from the White River. The topographical conditions are also better, and thus would require less preparation prior to actual disposal operations. If the plant site in Section 10, T10S, R24E, is used, these disposal areas on the same side of the river would be advantageous.

All of the potential spent shale disposal areas will be studied in detail prior to selecting a site for inclusion in our detailed development plan. The location of the spent shale disposal site is a critical environmental parameter that requires considerable evaluation. As mentioned earlier, retorted shale from a TOSCO II retort will have different physical characteristics than Paraho retorted shale. The amount of compaction, wetting, and draining will have to be analyzed as well as other important parameters. A considerable amount of our environmental program, and engineering evaluation will be directed to the problem of spent shale disposal.

2.4.4 Water Supply

Without detailed knowledge of the availability of ground water from dewatering the mine or deep aquifers, it must be presumed that the required water will come from the White River. If this is the case, and the plant site is as detailed in this report, a pipeline from the White River North to the plant in Section 10, T10S, R24E, would be required. A water storage reservoir adjacent to the plant will likely be required.

The water supply facilities could be shared with the lessee of Tract U-b. Another possibility would be the development of a regional water supply system for all of the oil shale potential in this area of Utah. Close coordination with Federal and State agencies will be maintained to develop the water requirements.

2.4.5 Support Facilities

We do not desire to build housing facilities for employees. Rather, it is thought that our role should be one of coordination and support in working with state and local officials of the area to develop area-wide community development plans. It is recognized that in the construction period, transitory employment will be high.* The demand for facilities will be almost instantaneous. This is not something unique to oil shale but is common to all industrial development. This prototype oil shale leasing program will serve to efficiently develop community programs.

2.4.6 Transportation and Access Plan

A primary all weather hard surface road (State Route 40) extends from Vernal, Utah, southeastward across the Green River to State Route 45, which goes directly south to Bonanza, Utah. From a point just north of the White River the road becomes a light duty, all weather road with improved surface. This road passes through the eastern section of Tract U-b and proceeds southeast to Route 207. The leasing stipulations indicate that existing road surfaces should be utilized where possible in development of the prototype lease sites. Under these guidelines Route 45 and possibly Route 207 would have to be improved to bear heavy duty traffic. The bridge crossing the White River at the Ignatio Stage Stop will also have to be inspected to determine if the structure can support heavy duty traffic.

* Figure 5 in Appendix shows manpower build-up by year and function.

Alternative access routes to the process plant site do exist and will be studied prior to submission of the detailed plan. Possible plant development on Tract U-b may provide the opportunity to jointly establish a heavy duty access route.

Other modes to meet the needs of heavy duty transportation will be investigated. We note that the Denver and Rio Grande Western Railroad is approximately 60 miles to the south in Unitah County. This same line - on a spur to Sunnyside, Utah - approaches within 60-65 miles to the west/southwest of Tract U-a. Access by rail would have to consider the appropriate by-passing of Desolation Canyon.

We anticipate that the upgraded shale oil product in the amount of 50,000 B/D will be transported via pipeline. Two major by-products from the plant, ammonia and sulfur, will be transported by truck to markets in the tri-state area. Coke may also be transported by truck. Truck transport would be utilized in lieu of the development of a railroad spur to serve the area.

As part of the detailed development plan Sun and Phillips will prepare a transportation and access plan including plans for right-of-way corridors for utilities and pipelines.

2.5 Schedule for Development

During the initial period covered by this Preliminary Development Plan, Sun and Phillips will obtain data on which a long-term development program and forecast of capital and operating costs for the project can be based. The effort during the initial period will be aimed at obtaining early approval of the detailed development plan, probably about the second

anniversary of the lease sale. When the approval of the detailed development plan is obtained, it is the intention of Sun and Phillips to spend during the third and fourth lease years amounts of money on operations under this lease on the Leased Lands for the development of the Leased Deposits which would qualify as credits against all or substantially all of the fourth and fifth bonus installments.

The objectives of the initial period of activity on Tract U-a will be: (1) to confirm the environmental, technical, and economic feasibility of the overall development scheme; (2) to prepare the detailed development plan required by Section 10(a) of the Lease; (3) obtain early approval of the detailed development plan, and (4) to initiate those activities necessary for commencement of detailed development promptly after such plan is approved.

During the initial Stage we will acquire and develop enough information to prepare a Detailed Development Plan and to begin the engineering design of the commercial production facilities. A concerted effort will be aimed at developing the technology required to meet our goals.

Listed below are the major tasks expected to be undertaken in the preliminary development period.

1. Environmental Programs
   a. Environmental Inventory
   b. Environmental Monitoring
2. Resource Evaluation - Oil Shale and Water
3. Mine Planning
4. Retorting Process Development
5. Shale Oil Upgrading

6. Waste Disposal Studies

7. Reclamation Studies

8. Siting Studies

9. Community Facilities Planning

10. Operations for Development of Leased Deposits.

Prior to obtaining an approved detailed plan our preliminary activity on the tract will be governed by CFR Title 43 Part 23 concerning surface exploration, mining and reclamation of public lands. The bar chart in Figure 4 indicates the activity and timetable proposed to prepare and submit a detailed development plan, and to commence commercial operation.

3.0 ENVIRONMENTAL MONITORING AND PROTECTION

3.1 Baseline Environmental Data Acquisition

The baseline data acquisition program described here is intended to provide predevelopment information on all aspects of the existing environment of Lease Tract U-a. Environmental information, along with engineering and economic data, will be used in the planning and design of oil shale mining and processing facilities.

Sun and Phillips plan to provide for all reasonable measures of environmental protection. In the operations on oil shale lease Tract U-a, adherence to this policy requires the acquisition of detailed baseline environmental information since it is required for anticipation of potential environmental effects. Baseline data will not only provide reference information with which to estimate development effects, but also will serve to increase understanding of basic ecological processes on which sound environmental protection measures can be planned.

3.1.1 Geology and Soils

In conjunction with the exploration and resource evaluation program to be conducted by Sun and Phillips, the topography and geomorphic history of the tract will be studied in detail as an aid in mining development and protection against environmental damage.

The geology and geomorphic history of the area will be used to assess and design the stability of slopes, canyon walls, and valley floors, particularly in those areas planned for spent shale disposal.

Although some general soils information on Tract U-a is available, neither the tract's specific soil types nor their distribution are known. Therefore, soil surveys will be conducted to obtain detailed information on soil types, depths, and physical and chemical characteristics, for the tract and surrounding area. This detailed analysis and soils mapping must precede the planning of environmental damage mitigation measures such as land reclamation and waste disposal. It is also needed for engineering purposes in the design and construction of roads, buildings, and other development facilities.

3.1.2 Meteorology and Air Quality

Baseline meteorology studies will involve first, a series of field surveys to characterize general air flow patterns. These studies are necessary to plan the distribution and installation of permanent meteorological instrumentation.

A meteorology tower will be installed at the proposed plant site with instruments to measure windspeed and direction, humidity, and temperature at several levels above the surface.

Tower data may have to be supplemented with upper air measurements; however, this would need to be determined. This upper air data could include observations on wind speed and direction and vertical temperature structure. It would be correlated with low level, continuous data on the same parameters measured on the meteorology tower to provide information on stability, temperature inversion frequency and depth, and the effects of these phenomena on emission dispersion. It is hoped that existing U.S. Weather Bureau data and models could be used for upper air studies.

Air quality sensors will also be located at the plant site to measure sulfur oxides, hydrogen sulfide, nitrous oxides, particulates, carbon monoxide, hydrocarbons, and oxidant level. Other sites for monitoring air quality will be selected on the basis of points of maximum and minimum concentrations of air pollutants, as estimated from the baseline meteorology studies.

3.1.3 Hydrology and Water Quality

Surface and ground water hydrology of the tract must be studied in detail, both for mining engineering, and environmentally, for planning development which will allow complete protection of water quality. Although most of the drainages in the area of the tract are classified as intermittent, periods of spring thaw and summer storms may be accompanied by short duration flows of high intensity. Stream gauging stations will be installed on each drainage in the tract area to provide data on water temperature, water quality, sediment load, and continuous flow.

Complementing the stream flow data will be data from precipitation gauging stations located throughout the tract area in a network which will yield accurate information on precipitation through all seasons of the year.

In addition to stream and precipitation data, the surface hydrology studies will utilize data on soils, geology, topography, vegetation, and other physical and biological features of the tract. Accurate estimates of water inputs to subsurface aquifers and of expected runoff amounts necessarily involve the integration of all these types of data.

The lack of groundwater information in the area of the tract requires that extensive test drilling to be done prior to any development. Test and observation wells will be drilled to obtain baseline information on groundwater amounts and quality. If water-bearing zones are located, each will be pumped and observed using standard procedures to determine drawdown rates, aquifer size, transmissivity, and other factors.

The quality of both surface and groundwater from all stream gauging stations and water wells will be ascertained during the baseline program. Constitutents to be measured will include all those regulated by state or federal law, or which may be required by the mining supervisor, at a minimum. In addition, water samples collected from both surface and ground sources will be tested for trace elements, to determine their presence or absence prior to any development operations.

In addition to samples collected routinely at all gauging stations, water from all streams, springs and seeps located on the tract will be tested for quality.

3.1.4 Vegetation

The natural vegetation of the lease tract will be studied to map the distribution of major vegetation types, and the species composition and density of each type and site. The initial vegetation type surveys will be conducted with the aid of infrared aerial photographs, coordinated with ground sampling. The resulting vegetation type maps will be used as a basis for subsequent detection of gross changes in distribution or condition in the long-term environmental monitoring program.

Following type-mapping, detailed investigations of species composition and vegetation density of each type will be conducted by conventional ground methods.

3.1.5 Wildlife

The likelihood of occurrence of particular wildlife species can be inferred from habitat distributions patterns, using existing knowledge on plant-animal relationships developed in other areas of ecological similarity to the tract area. However, quantitative information on particular species which occur in the lease tract area can only be obtained by extensive field sampling. Wildlife populations inhabiting the lease tracts will be sampled to estimate their seasonal density and distribution. These field studies will employ techniques routinely used by wildlife managers in the region, and will be planned with sampling designs which will permit valid statistical projections of population sizes throughout the area. In the baseline studies, all species will be studied, including mammals, reptiles, amphibians, birds, and fish.

Some species will receive greater attention due to their economic or ecological importance. For example, the Utah area is known to support significant populations of mule deer, a species of considerable recreational importance in the region. Therefore, intensive sampling through all seasons of the year will be employed in studies of that species. Rare or endangered species will also receive more intensive study. In this category, species which may be encountered include the black-footed ferret, peregrine falcon, prairie falcon, and bald and golden eagles.

The only fish habitat on the tract is in the White River. This requires the exercise of great care to prevent the contamination of surface or ground water which could be transmitted to the river. Gauging stations will be installed in the surface hydrology studies, to measure run-off and water quality in all minor drainages on or near the tract. Water quality in the White River will also be monitored up-stream and down-stream from the oil shale operations. Ground water quality will be determined for each test and observation well drilled on the tract.

3.1.6 Archaeology and Historical Sites

There are no known historic or archaeological sites on the tract itself, but evidence has been discovered nearby of at least one early Indian culture. In addition, there are several historic sites in the area, including the old Uintah Railroad, a stage stop and crossing on the White River, and old gilsonite mine workings. Before any development on the lease tract, specialists in regional archaeology and history will be employed to survey the tract for important sites, and to estimate the likelihood of discoveries during development operations. In addition, routine observations, during mining and other development activities, will be conducted to assure recognition of significant discoveries, should they be made.

3.1.7 Social-Economic Considerations

Utah Tract U-a is somewhat remote from the nearest communities, Vernal, Utah, and Rangely, Colorado. A 50,000 barrel per day oil shale industry in Uintah County would generate an estimated population increase of approximately 8,400, including employees, their families, and related community service operations. Although Vernal and Rangely will probably absorb most of the population increase for the first few years,

particularly during construction, long-term oil shale development will likely result in the establishment of communities nearer the development area. It is Sun's and Phillips' intention that local city and county governments maintain control over the planning which will be required to assure orderly growth in the region. However, the companies realize their responsibility to assist these efforts, and are willing to participate in such planning to the extent desired by local authorities.

Although tax revenue increases generated by an oil shale plant will be considerable, the time lag before generation of these revenues could be several years following the start of development. Sun and Phillips believe community development by the private building industry to be more desirable.

3.2 Environmental Monitoring

3.2.1 Air Quality

Air quality monitoring stations, including instrumentation for measurement of pollutant concentrations listed in section 4.1.2, will be maintained for the life of the lease. The exact number and locations of stations cannot be specified yet; these will depend on results of the baseline meteorology studies and subsequent detailed planning of plant and mine locations.

3.2.2 Water Quality

Operation of the stream gauging stations installed during the baseline program will be continued throughout the lease operations. The surface and ground water quality sampling program established during baseline data acquisition will also be continued permanently, and records will be maintained.

Of particular importance will be the monitoring of water quality in the vicinities of spent shale disposal areas. Ground and surface water quality will be monitored both up and down gradient on each of these sites.

3.2.3 Ecology

The general ecology of the lease area will be monitored for the duration of the lease to detect any changes which might occur as a result of oil shale operations.

Included in this program will be regular sampling of the abundance, distribution, and variety of wildlife, especially those species considered of greater importance by regional wildlife authorities, or which are known to be rare or endangered.

Vegetation distribution and condition will also be regularly monitored. Using vegetation distribution maps constructed during the baseline program, changes in condition or distribution, relative to baseline conditions, will be determined by annual infrared aerial photographic surveys. More frequent, ground inspections will be instituted, as required.

The scheduled aerial vegetation surveys will also serve as the primary means of discovering any areas of new or increased soil erosion which may occur. If such areas are detected, ground inspections will be conducted to determine the causes.

3.3 Land Reclamation

There are two distinct types of land reclamation which will be required during shale oil production. First, the revegetation of disturbed soils will be conducted on areas temporarily disturbed in construction and mining operations. This type of reclamation will be adapted from

revegetation technology developed for improvement of semi-arid western ranges. It is expected that little, if any, additional research will be required for a successful revegetation program.

The other type of reclamation involves the establishment of suitable vegetative cover on spent shale piles. Limited research on vegetation of spent oil shale indicates the process can be successful, if the shale is properly prepared, and the growing plants are adequately fertilized and irrigated. However, many questions remain regarding field methods which are applicable under particular conditions of soil type, elevation, slope, and other important site characteristics.

3.4 Environmental Design Considerations

The underground, room and pillar mining plan described in this report will require comparatively little surface disturbance. The mine portals, ore conveyors (or haul roads), and mine ventilation raises will all be designed with the least practicable disturbance of the surface environment.

Among the environmental protection features which may be incorporated in the mining plan are landscaping and building construction designs at the portals which will blend with the natural scenery. In the event ore is moved from the primary to the secondary crusher by conveyors, all conveyors will be designed to minimize dust. All permanent haul roads will be designed for minimum dust problems, and crushing equipment will be designed with extensive dust suppression facilities.

The retort plant site, tentatively planned as described in Section 2.4, will be finally selected only after detailed studies of the tract's meteorology are completed. The studies are expected to yield

important information on temperature inversions and emission dispersion patterns which will directly influence final plant site selection.

3.5 Environmental Planning

The development of oil shale on Tract U-a will, by necessity, cause changes in environmental conditions. However, we believe that comprehensive environmental planning prior to development will minimize environmental impacts and will "encourage productive and enjoyable harmony between man and his environment," as is the nation's policy as defined in The National Environmental Policy Act of 1969.

This section is concerned with the environmental planning associated with oil shale development.

3.5.1 Rehabilitation Planning

Probably the major environmental concern is the disposal of retorted shale and rehabilitation of disposal sites. At least during the initial years of plant operation, the spent shale will be disposed of above ground. One of the major concerns in any land rehabilitation plan is the early identification of future uses for the rehabilitated land. Our current information suggests that the land in and surrounding Tract U-a will remain primitive and very sparsely populated. As population increases in near-by areas, one might anticipate that the tract area will find greater use for recreational value such as camping and hiking. Thus, rehabilitation plans should emphasize retorted shale disposal and rehabilitation in a manner that perpetuates use of this land for primitive recreational value. Prior to development of a rehabilitation plan, we will seek the advice of the Bureau of Land Management and the appropriate agencies within the State of Utah government.

Retorted shale will be transferred to the disposal site from the retort area by truck and/or conveyor. The retorted shale will be graded, compacted, and contoured in order to blend into the natural contours of the land. Slopes will be generally less than 1:4 rise to reduce any possible shift in the shale pile. The consistency of the shale from the Paraho kiln is expected to be coarse (+1/4" -3") and should not be a significant source of dust. Once an entire area is graded and compacted, some leaching of the shale will occur during rainstorms or from the wetting process. Run-off from the leaching, plus the surface water run-off from rain or snow melting, will be contained in a dammed or containment area at the downstream base of the disposal site.

Revegetation of disposal sites will be initiated as soon as practical to minimize the time that the land is in a disturbed condition. Nominally, revegetation plans will key to an annual spring or fall planting of native grasses and bushes. Supplemental watering and fertilizer addition will follow. Sun and Phillips also plan to conduct studies (and possibly support additional research studies at the university level) directed toward acceptable revegetation of spent shale sites. One currently unknown parameter is the revegetation characteristics of Paraho-retorted shale. We expect the texture of this spent shale to be more granular and coarse than shale produced by the TOSCO II process. Coincidental with the development studies on Paraho technology, we plan to conduct initial revegetation studies on the shale from the Paraho retort. Results from such studies will be available for inclusion in the Revegetation Plan as submitted in the detailed development plan.

Two plans for erosion control will be prepared in the formal rehabilitation plan. The first concerns plans to control high salinity leachate from disposal pile run-off. Sources of this leachate are expected from natural storm water run-off and from artificial watering to enhance revegetation. The run-off water will be impounded at the down-stream base of the disposal pile. From this impoundment the water will either be transferred to a process water storage pond or reused directly as process water.

The second form of erosion control concerns a plan for compacting, contouring, and planting to insure that the retorted shale pile remains stable and does not seriously erode during periods of thunderstorm activity.

The detailed development plan will contain the formal Rehabilitation Plan. Prior to submitting and obtaining an approval of the detailed plan, any request to conduct exploration activity on U-a, Sun and Phillips will submit to the Mining Supervisor a specific rehabilitation and erosion control program covering such exploration activity. Such exploration activity, together with the rehabilitation program, will be conducted under Part 23 CFR - Surface Exploration, Mining, and Reclamation of Lands.

It is important to note that the final Rehabilitation Plan will be developed after consultation with Federal and State of Utah personnel. The Soil Conservation Service has direct responsibility in this area and we plan early and frequent contact with this agency. This is an important environmental concern that requires joint discussion, planning, and coordination prior to plan development. Also, due to the proximity of Tract U-b and near-by private lands held for oil shale development, a consideration

of area rehabilitation plans is required in development of U-a plans. In this regard a single shale disposal site serving Tract U-a and U-b is also a logical consideration.

3.5.2 Oil and Hazardous Materials

Sun and Phillips contingency plan for oil and hazardous materials will be prepared in accordance with National Oil and Hazardous Substances Pollution Continegney Plan and the Oil Pollution Prevention regulations. It is our understanding that the National Oil and Hazardous Substances Plan is directed toward Federal agencies and provides for an integrated Federal/State government response in order to protect the environment from the damaging effects of pollution discharges. Sun and Phillips plan to cooperate fully with Federal/State agencies in order that they will be able to fulfill their responsibility under this regulation.

Another major effort will be directed toward preparation of Spill Prevention Control and Counter-measure Plans (SPCC Plan) as described by the Federal EPA Oil Pollution Prevention regulations applicable to Non-Transportation Related Onshore and Offshore facilities. These regulations establish procedures, methods, and equipment to prevent the discharge of oil into or upon navigable waters of the United States. The White River, which generally forms the northern boundary of Tract U-a, is navigable waters of the U. S. Furthermore, the definition of navigable waters is being interpreted very broadly to include dry wash flows that flow seasonally or intermittently after a heavy rain and subsequently flow into other waters (e.g., the White River).[1] On this basis, the U.S. Geological Survey maps of

(1) U. S. EPA - Office of Enforcement and General Counsel - letter dated December 5, 1973, to Director Enforcement Division Region VIII.

Tract U-a indicates many miles of intermittent streams that flow during snow melting or heavy shower conditions. The majority of this wet weather run-off flows into the Southam Canyon area and ultimately may flow into the White River. In the extreme western portion of U-a, these intermittent streams flow westward into Asphalt Wash and ultimately into the White River.

Sun and Phillips intend to develop an SPCC Plan for any facility that could reasonably be expected to discharge oil into intermittent streams or the White River. These plans will be developed in accordance with existing (or amended) regulations as described in the December 11, 1973 Federal Register. An SPCC Plan will be developed for crude shale oil storage, finished product storage, and any process unit that may reasonably have a damaging oil spill. We also believe that there may be other liquids generated at the oil processing site that may require contingency planning in the event of an unexpected spill. Also, our current processing plant produces substantial ammonia as a by-product; a spill contingency plan will be considered for this material.

3.5.3 Fish and Wildlife Plan

A fish and wildlife management plan will be submitted as part of the detailed development plan. Generally, we believe that Tract U-a does not serve as a primary habitat for wildlife. However, Tract U-a likely does serve as a transitory site for limited wildlife use. The bi-monthly base-line monitoring survey will provide data on wildlife species, distribution, and abundance. It will be the goal of the wildlife management plan to minimize the impact of oil shale on the wildlife found on U-a. Such a plan will avoid damage to wildlife where practicable and provide alternate habitats where disruption is unavoidable.

The Fish and Wildlife Service within the Department of Interior has direct responsibility and will be contacted early in the development of baseline data and plan development. We anticipate that the baseline and early years of the monitoring program will be conducted by a contractor in order that professional and experienced personnel can be employed in the study.

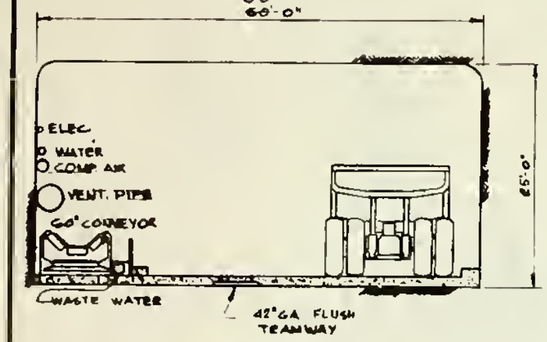
3.6 Environmental Reporting

The chart in Figure 4 indicates the steps necessary to prepare the detailed development plan for Tract U-a. It is anticipated that work on the tract site could begin by September 1974. Exploratory work on the tract will be conducted only after approval of the Mining Supervisor and under CFR Part 23. The target date for submission of the detailed development plan is the 4th quarter 1975 to 1st quarter 1976. Rapid approval of the detailed plan will be sought in order for the lessee to take full advantage of early on-tract developmental expenditures as credit against the fourth and fifth bonus payments. The second year of baseline environmental data will be gathered and reported after the detailed development plan has been submitted and any necessary changes made to the plan as required.

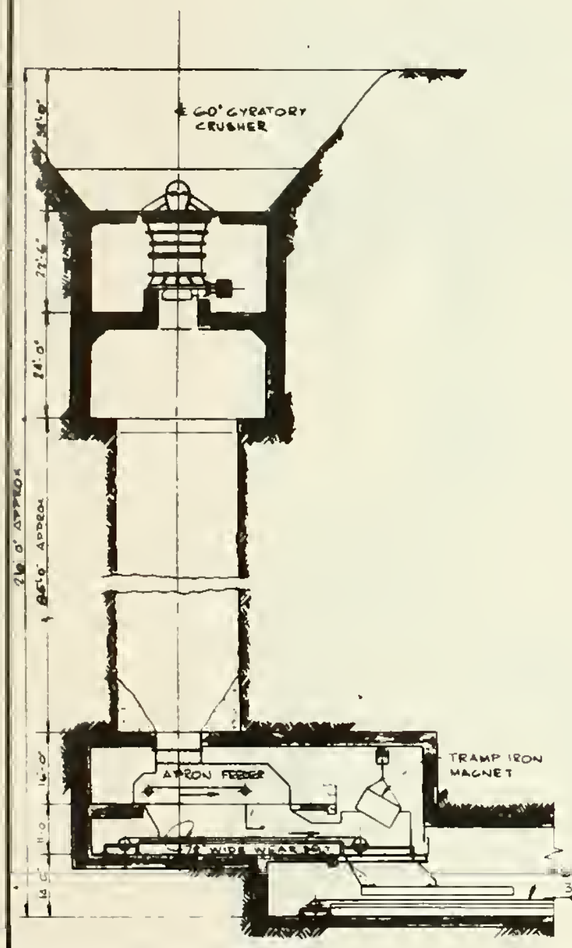
After obtaining approval of the detailed development plan, an annual report will be prepared for the Mining Supervisor on the following lease anniversary date. This report will indicate the status of programs defined in the detailed plan. This annual report will also contain the information generated in the ongoing environmental monitoring program.

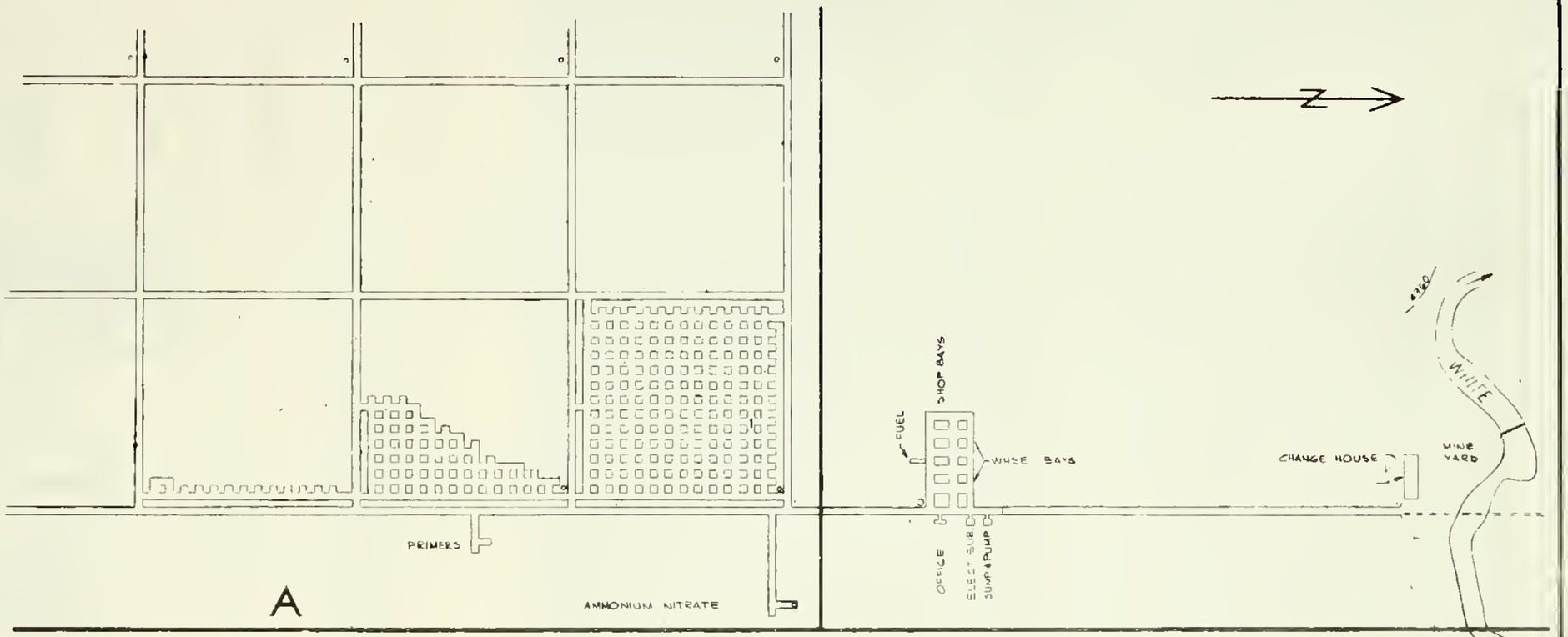
Sun and Phillips will provide environmental briefings as specified in the environmental stipulations of the prototype leasing program.

SECTION 4

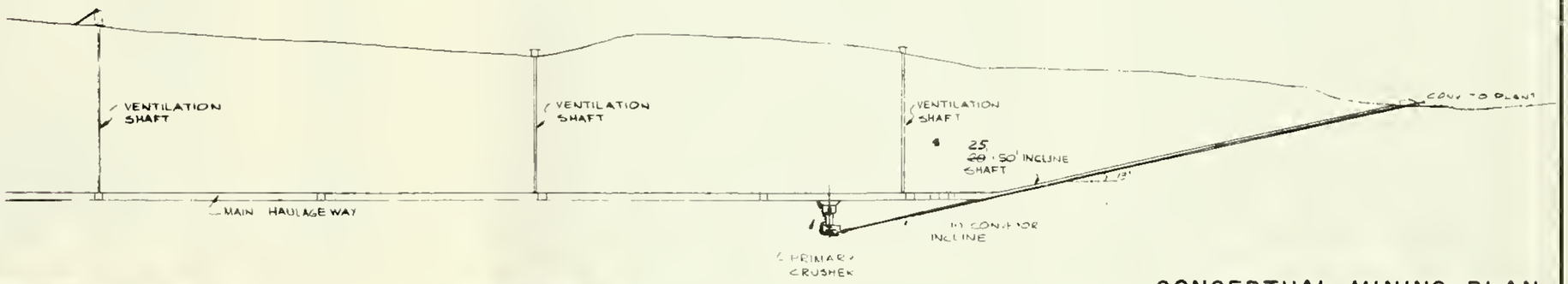


INCLINED SHAFT
CROSS SECTION
SCALE 1/8"=1'-0"





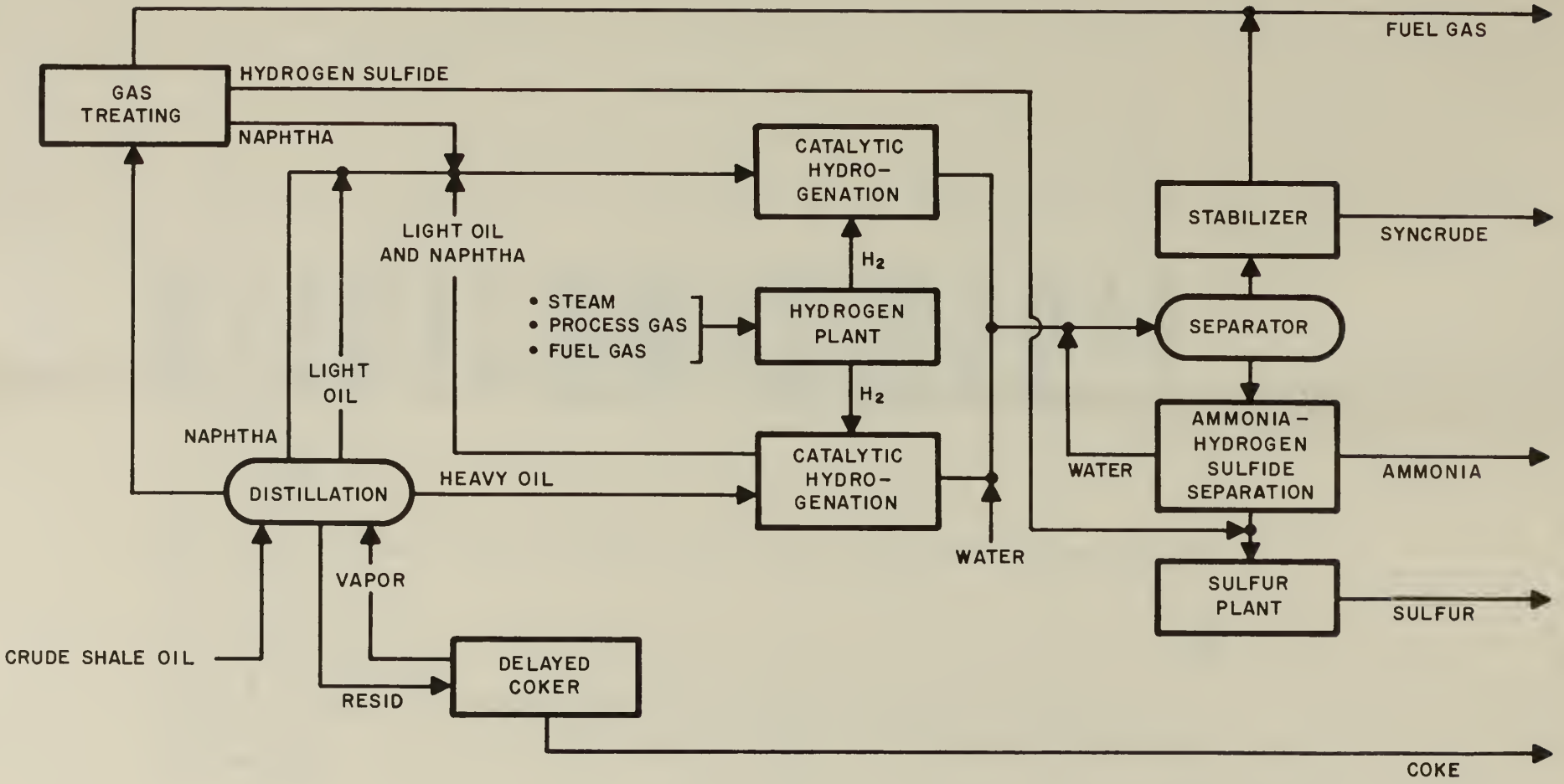
PLAN
SCALE 1"=400'-0"



SECTION
SCALE 1"=400'-0"

CONCEPTUAL MINING PLAN
UTAH TRACT U-a

FIGURE 1



FLOW DIAGRAM FOR UPGRADING CRUDE SHALE OIL

FIGURE 2

FIGURE 4

UTAH DIL SHALE TRACT U-a

TENTATIVE SCHEDULE FDR TRACT DEVELDPMENT
(FDR GUIDANCE DF MINING SUPERVISOR)

1. AWARDING OF LEASE
2. PROJECT STAFFING
3. PROJECT PLANNING AND INITIAL CDNTACT WITH GOVERNMENTAL AGENCIES
4. ENVIRONMENTAL BASELINE STUDY
5. ON-SITE EXPLDRATORY DPERATIDNS INCLUDING MAPPING, CDRING, HYDROLOGIC STUDIES, SITE EVALUATIONS, ETC.
6. OFF-TRACT DEVELOPMENTAL AND ENGINEERING STUDIES ON MINING, RETORTING, UPGRADING
7. REVEGETATION AND REHABILITATION STUDIES
8. PREPARE ENVIRONMENTAL MONITDRING PLAN, TRANSPORTATION AND ACCESS PLAN, FISH AND WILDLIFE MANAGEMENT PLAN, OIL AND HAZARDOUS MATERIALS SPILL PLAN, EROSION CONTRDL AND REHABILITATIDN PLAN, AND DETAILED COMMERCIAL PLANT DESIGNS
9. SUBMIT DETAILED DEVELOPMENT PLAN
10. APPROVAL OF DETAILED PLAN BY MINING SUPERVISOR
11. MINE DEVELOPMENT, PLANT ENGINEERING PROCUREMENT AND CDNSTRUCTIDN
12. COMMERCIAL PLANT PRODUCTION
13. INITIATE SURFACE REHABILITATION PROGRAM
14. ENVIRONMENTAL MDNITDRING AND IMPACT ASSESSMENT

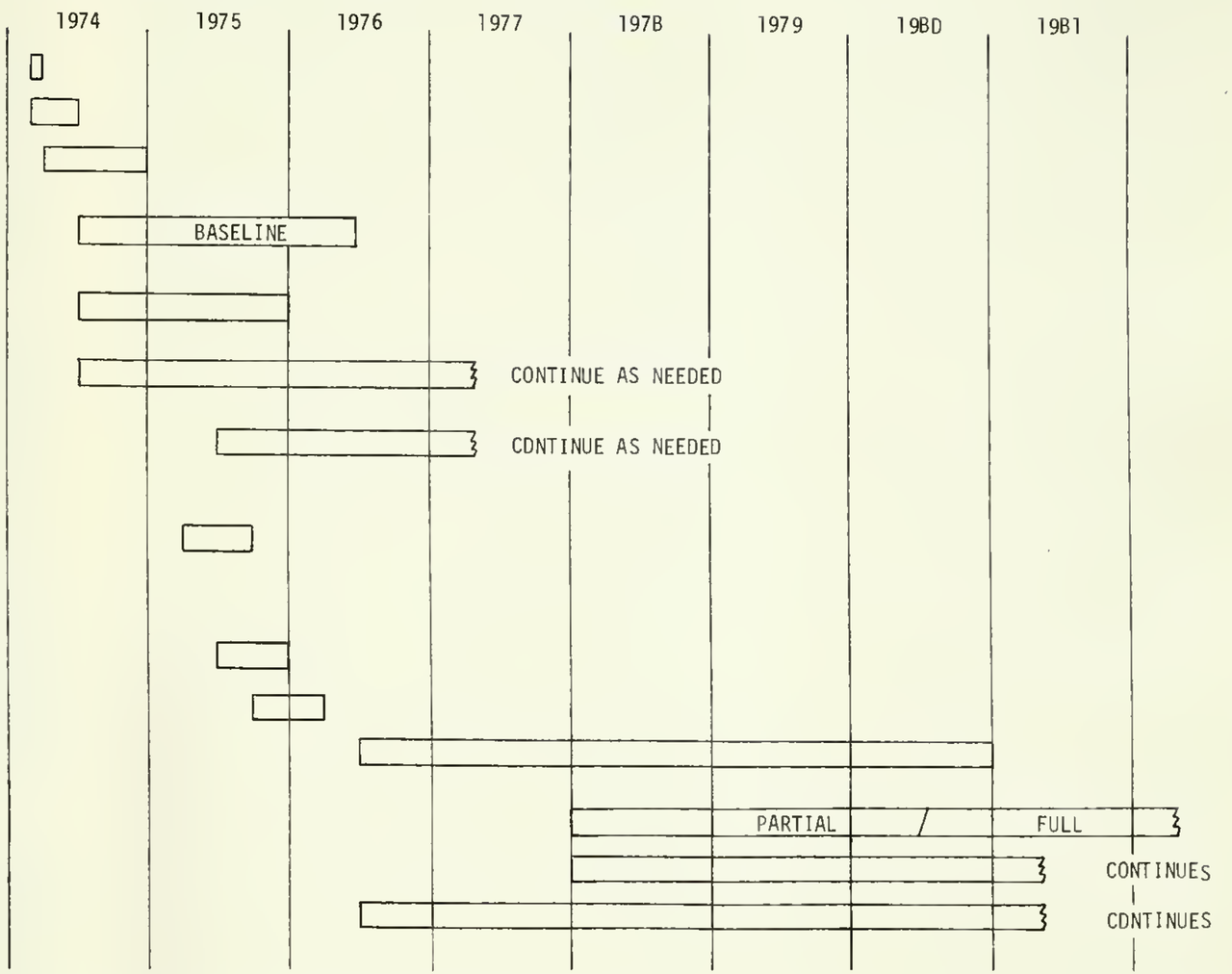
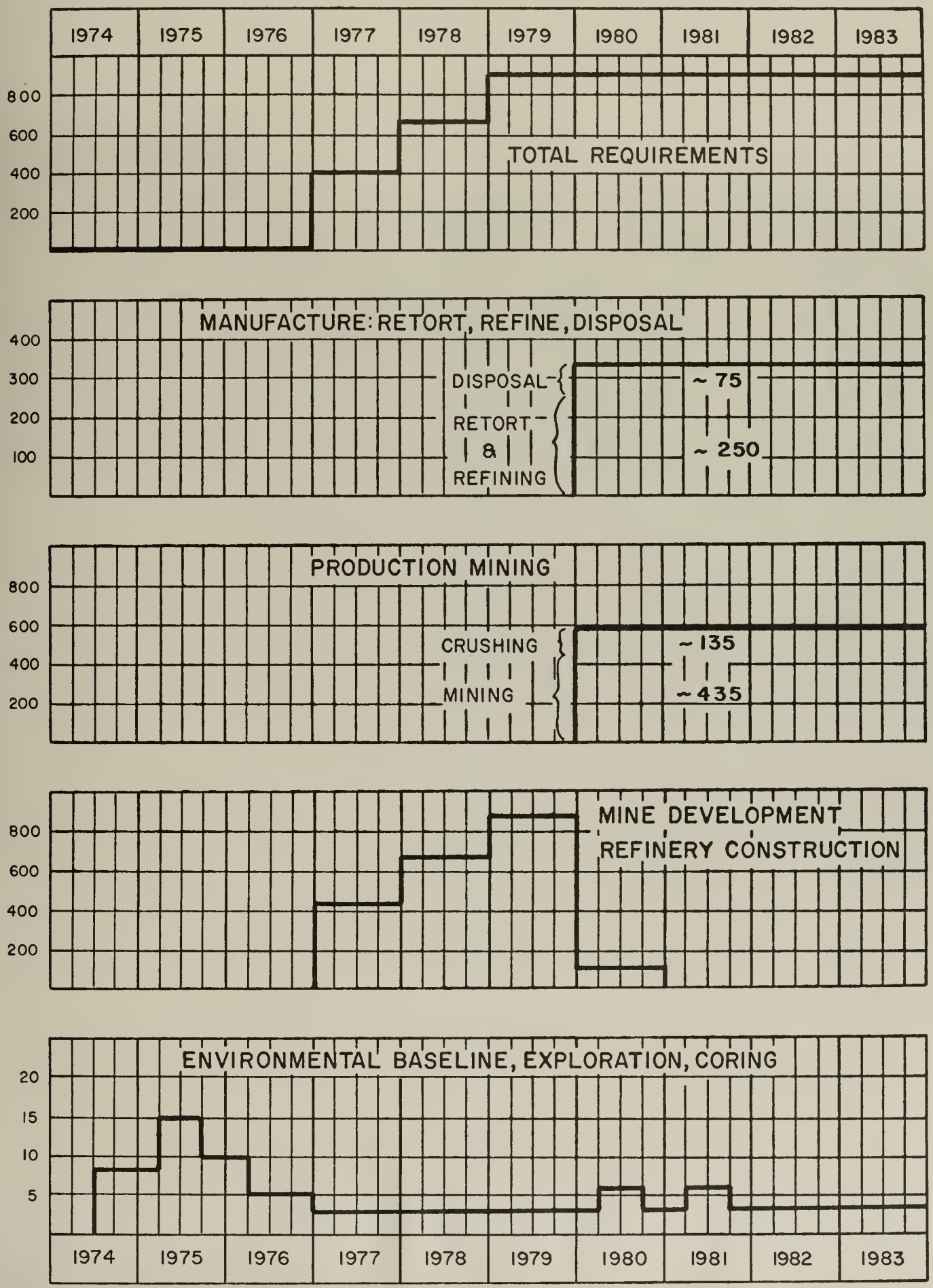


FIGURE 5

MANPOWER REQUIREMENTS

BY YEAR AND FUNCTION



RETORTED SHALE DISPOSAL AREA V
RETORTED SHALE DISPOSAL AREA IV
PLANT SITE LOCATION II
PLANT SITE LOCATION I
COARSE CORE STORAGE
CRUSHERS
RETORTS
MINE YARD
PORTAL
MINE LOCAT
INCLINED
SHAFT
UNDERGROUND SHOP
MAIN HAULAGE
SOUTHMAN CANYON GAS FIELD
WHITE
RIVER
RETORTED SHALE DISPOSAL AREA III
MINE ENTRY LOCATION II
A
RETORTED SHALE DISPOSAL AREA II
RETORTED SHALE DISPOSAL I
Asphalt
Wash
GAS FIELD
Center Fork
(ARCHY BENCH SE)
SCALE 1:24 000
109°15'
2 640 000 FEET
12'30"
(RAINBOW)


PROTOTYPE OIL SHALE LEASING PROGRAM
TRACT Ua
UINTA BASIN, UTAH
ALTERNATIVE LOCATIONS FOR
MAJOR SURFACE FACILITIES
FIGURE 3
WHITE RIVER
Weaver
Hells Hole
Hells Canyon
Cowboy Canyon
Evacuation Creek
Pumping Station
Drill Hole
Ore Storage Ponds
Ore Storage Pond
Bonanza
PIPELINE
TRENCH
R. 24 E.
10' R. 25 E.
RAINBOW 3.9 MI.
109°17'30"
2 670 000 FEET (UTAH)
DRAGON 8 MI.